A Simulation Approach to Improve the VANETs Communication

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Abstract—VANET ("vehicular ad hoc network") is a type of networks that consist of many vehicles acting as moving nodes. They are connected with other vehicles through an ad hoc wireless network so as to increase traffic security and provide relaxation to road users. Sending the messages to the final destination in VANETs is a challenging mission because of its relatively high mobility and dynamism. The clustering technique addresses such issues, as it gathers vehicles based upon several predefined metrics such us density, speed, and physical vehicles locations. Clustering in VANET is one of the controller techniques for dynamic form. In this paper, a new method is presented for clustering that suits the VANET environment with the purpose of improving the network cluster stability. This method takes a number of parameters into consideration, such as the coverage area and speed to make the cluster structure comparatively stable. In addition, and advance is obtained in tems of the cluster-head selections algorithm, and the data exchange is improved through clusters.

Keywords—VANET, vehicular ad hoc network, clustering, cluster head, cluster member

1 Introduction

The technology of Vehicle-to-Vehicle offers a connection between vehicles through an ad hoc wireless network, and removes the necessity for a main station to control the network topology. The vehicular ad-hoc networks (VANETs) are categorized by the self-arrangement of vehicles and fast modifications in network structure due to their high speed. As breakdowns in connection relations often happen in VANETs, guaranteeing the stability of communication is extra difficult in VANETs as compared to normal MANETs. An actual and low-cost solution to decrease the mobility effect and develop the VANET network connectivity involves forming a clustering with hierarchical structure inside the network [1–12]. The clustering procedure is the separation of networks into small groups. Many parameters affect the clustering, such as the distance between nodes, capability of link communication, and the improvement of a comprehensive network presentation. Small clusters can work more efficiently [3–9]. The ground network vehicles are divided into simulated groups recognized as clusters through the clustering method. The latter can offer an active solution for the abovementioned problems. A vehicle is select to manage the connection among its Cluster Members (CM), called a Cluster Head (CH) an interacts with other sheets of a mutual network [2–11].

2 Related work

A number of VANET studies among the related works have paid attention to the development of grouping procedures, most of which depend on MANET grouping methods. A number of the most important protocols are defined below.

In [5], the important idea of Affinity Spread is applied in the suggested clustering algorithm, and the Cuckoo Search (CS) optimization algorithm is applied to find out the best cluster-head. In the network, each node transfers the accountability and obtainability messages to its neighbours, after which it creates a self-sufficiently clustering decision. In [1], the Angle based Clustering Algorithm (ACA) is suggested by the authors, which exploits the vehicles track and angular location for choosing the best cluster heads vehicles that remain unchanged for a long time. The simulation outcomes discover that ACA significantly outperforms other clustering protocols in terms of cluster stability.

As for the authors in [6], they state that vehicles are movable at the equal way section whenever they share the same ID and exist within the communication range of its neighbour for appropriating the creation process of clusters. This is due to the concept which states that all expected security messages are common among vehicles close to their own relative speed to avoid a dangerous situation. To determine CH, some metrics are defined depend on vehicle motion information. Vehicles are associated with a preset weight value based on their importance. A vehicle that has a top value of weight is selected to be a main head of cluster (MCH). A secondary head of cluster (SeCH) is presented as a holdup for the MCH to develop the cluster's stability. The control is converted to SeCH whenever the PCH cannot perform the action.

The work in [3] suggests the "grasshoppers optimization-based node" algorithm for clustering VANETs (GOA) to select the optimal cluster head. The suggested algorithm concentrated on overhead of network within unexpected density situations of node.

Regarding the study in [2], the researchers propose a clustering algorithm that is stable for vehicular ad-hoc networks (SCalE). There are two features originally combined in the algorithm: information about vehicles performance to get effective CHs collection, and the engagement of a CH holdup to keep the cluster structure stability. With simulation procedures, these are exposed to stabile growth and increased execution whenever matched to current algorithms of clustering.

3 System model

Clustering in VANET represents a process of collecting the neighbouring moving vehicles on a street within stable groups to facilitate the process of exchanging information between vehicles.

A highway model is considered with high density wherein vehicles travel in a direction way. Assuming that vehicles are able to connect with each additional to exchange information such as protection messages, the network consists of a number of vehicles located on the street, which are considered as a members of several groups on behalf of each group one of its members to be the head of the group (CH). The CH is characterized by a set of features such as location, direction, and stability. All groups change over time depending on the speed and density of vehicles, as each time a new head is chosen for the group. The cluster head transmit the message that was received from one of cluster members to another cluster head vehicle in the neighbour cluster across the network until the message arrived to the target vehicle. Figure 1 illustrates the clustering model.

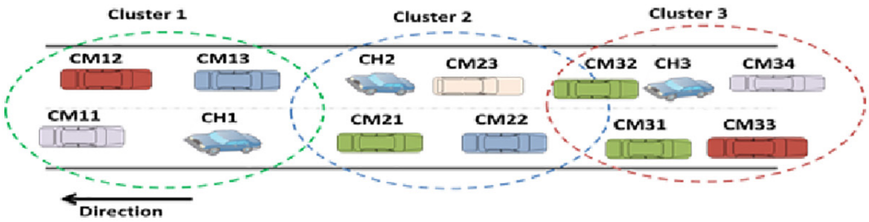

Fig. 1. Illustration of the clustering model

4 Implementation

4.1 Cluster composition and cluster head selection

Initially, the network consists of a number of vehicles on a road, divided into multiple vehicle groups within its transmission range. Each group consists of number of vehicles as members (CM), and the cluster head (CH) represents the leader of the group. The first CH is selected randomly, after which the vehicle farthest within the range of the first head, which is located towards the direction of the target vehicle, is determined as a second cluster head. All vehicles that fall within the range of the head are considered as members of the group. Figure 2 explains the cluster composition steps.

Fig. 2. Cluster composition steps

Algorithm 1. Cluster composition and cluster head selection

1. Set all vehicles on the highway (randomly)
2. Set each node's track (Randomly)
3. Assign the speed of each vehicle
4.select the first CH
5. Determine the sender vehicle
6.put all vehicles in the range of the FCH in the in the first cluster.
7. WHILE (Nodes! = empty)
8. Fined the next CH(in direction of the receiver and the furthest from the current CH)
9. Nodes clustering = All Node
10. Update clusters by change the CH during specified time
11.end while
12. End

Fig. 3. Algorithm of cluster composition and CH selection

Figure 3 shows the algorithm of cluster composition.

4.2 Message sending

Whenever the vehicle needs to send a message to another vehicle, the message is transmitted to the CH within the same group, which in turn sends the message to the CH within its transmission range towards the target vehicle. Each time, the members and cluster head may be changed depending on the speed, position and stability of the vehicles in the group, in addition to a number of other characteristics. Figure 4 shows the algorithm of message sending.

Algorithm 2. Message sending

1. Select the first CH
2. Determine the sender vehicle
3. Determine the receiver vehicle
4. Send the message to the CH in the same cluster of the sender
5. Find the next CH
6. Send the message to next CH
7. WHILE (next vehicle! = receiver)
8. Find the next CH (in direction of the receiver) and send the message to it
9. End WHILE
10. End

Fig. 4. Algorithm of message sending

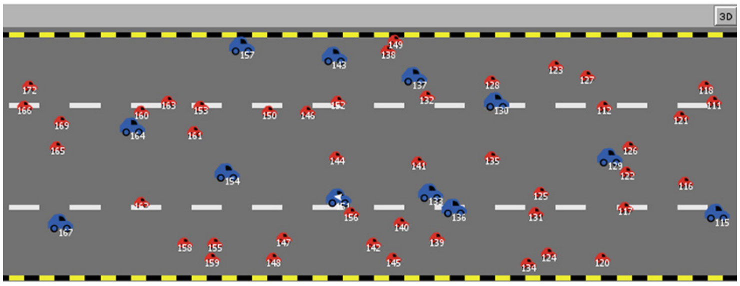

Fig. 5. Clustering in vehicles process

Figure 5 shows the vehicle process. To calculate the stability of the cluster and entire presentation for the suggested algorithm, the following metrics can be used:

1. Average cluster head duration: Longer head of cluster periods are significant for dependable connection security.
2. Average number of cluster member duration: Adjudicators for the first clustering stability.
3. Cluster life time metric: Determining the stability of the cluster.
4. Reliability: A collaboration of network capability to perform the aimed process such as "communication". Greater system reliability implies a more secure network [10–8].

The presentation of the suggested algorithm matches the works of [5] and [6]. The stability of the cluster is attained with the suggested algorithm. Node movement through the dynamic environment is taken into consideration to develop the cluster stability, member of cluster, and the head of cluster. It also rises the presentations of the cluster. The cluster stability, reliability, and network life time are reached at the dynamic environment. The stability of the suggested algorithm presentation suits the cluster stability for its large CH and CM periods, which has been achieved through the suggested algorithm. The network reliability and the life time of it are also improved [13].

5 Results

The Table 1 shows the number of cluster heads at different times, as the number of clusters varies depending on the number of cars on the street, coverage area, and their speed and density in a specific location. To exemplify, the number of CH in the first time is 18 while in the last time it is 20.

The Table 2 contains a model for a group of clusters and the number of members for each cluster at different moments of time. At one time, it shows the number of members in each cluster of clusters in existence, and the number of members for the same clusters at five other different times.

Table 1. Number of clusters

Time	Number of CHs
1	18
2	20
3	21
4	19
5	20

Table 2. Members count

Time / Cluster	T1	T2	T3	T4	T5
C1	5	8	7	5	4
C2	6	6	4	9	6
C3	4	5	5	7	7
C4	7	4	6	4	6
C5	3	5	9	5	5
C6	8	9	3	6	7
C7	9	6	8	2	8
C8	5	3	1	5	7
C9	2	4	9	8	5
C10	4	7	6	4	3

6 Conclusion

In VANETs, changing the density of nodes and situations of the traffic, as well as active information exchange, are very stimulating. This paper offered a new clustering method that depends on a highway state for proper communication by picking effective CHs in high, medium, and low node density environment to improve data exchange. The algorithm suggested for the execution of cluster formation involves the standard base-station of direction, location and speed. The CH node is selected via these standards. The CH node connects with the CM that share a similar coverage area, direction and speed. Later on, the CH can be exchanged occasionally to uphold the foundation cluster. The proposed algorithm provides a high stability, suitable for aggregation in a dynamic environment to obtain a sufficient stability.

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